COURSE SYLLABUS
GG651 Geomagnetism, Cosmic Magnetism, Paleomagnetism, Environmental and rock magnetism
Fall of 2023
Class: 17:30 to 18:45 pm, Mondays and Wednesdays August /21st- to December/15th, 2023
Classroom: POST 723 and 715
Instructor: *Emilio Herrero-Bervera*
Phone: 956-6192, 956-4879 and 956-5227,
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Office hours: After class or arranged in POST 716A and/or 715

Target Audience and Course Content
This class is about the study of the generation of the Earth's magnetic field and the recording of the present and past paleofield by both rocks and other materials such as organisms and other magnetic materials from Earth as well as extraterrestrial bodies. The emphasis will be the study of Environmental Magnetism, Rock Magnetism Biomagnetism, and extraterrestrial magnetism.

This class will study both the global and local phenomena from a magnetic perspective. It is suited for students who:

i) are preparing for a career in the environmental and geotechnical fields in industry or academia.
ii) Want to know more about the rock magnetic properties of the environment around them
iii) Plan to pursue the new GGMGeo professional masters degree.

This course will cover natural and anthropogenically produced problems of the planet's interaction with the crust, the hydrosphere, biosphere and atmosphere. This class will analyze the application of rock and mineral magnetic techniques to situations in which the transport, deposition, or transformation of magnetic grains is influenced by environmental processes in the atmosphere, hydrosphere and lithosphere. Course content is mainly based on applied paleomagnetism, with supporting rock magnetism and extraterrestrial magnetism, magnetostratigraphy, susceptibility, relative paleointensity and magnetic mineralogy.

Topics include:
Magnetic Susceptibility
Relative paleointensity
Paleosecular Variation and magnetostratigraphy
Magnetic mineralogy
Magnetic properties of solids
Natural Magnetic minerals
Magnetic properties of natural materials
Depositional processes, i.e. currents, sorting, reworking…
Depositional components, i.e. detrital, biogenic, chemical…
Postdepositional, processes, e.g. compaction, diagenesis, pedogenesis, fluid migration..

Origins of magnetic minerals in sedimentary environments
Transformations of magnetic minerals in sedimentary environments
Dissolution of Magnetic minerals in Marine and lake environments
Biomagnetism
The North Atlantic as a Quaternary magnetic archive
Paleomonsoons I: the magnetic record of paleoclimate in terrestrial loess and paleosol sequences
Paleomonsoons II: Magnetic records of Aeolian dust in Quaternary sediments in the Indian Ocean
Bacterial Magnetite and the Quaternary record
Magnetic monitoring of air-land-and water pollution
Magnetic cyclostratigraphy: high-resolution dating in and beyond the Quaternary and analysis of periodic changes in diagenesis and sedimentary magnet.ism

Text Books: **(i)*Paleomagnetism**: Magnetic Domains to Geologic Terranes by Robert F. Butler. I will provide the students with a free electronic copy of the book

(ii)**Quaternary Climates, Environments and Magnetism** by Barbara Maher and Roy Thompson. I will prove the students with a free hard copy and/or electronic copies of several chapters of the book

(iii) **Environmental Magnetism** by Roy Thompson and Frank Oldfield. I will provide the students with a free hard copy and or an electronic copy of the covered chapters of the book.

(iv) **The Magnetic Anisotropy of Rocks** by D. H. Tarling and F. Hrouda. I will provide the students with free electronic copies of the material covered of this book.

(v) **Encyclopedia of Geomagnetism and Paleomagnetism,** D. Gubbins and E. Herrero-Bervera, Springer.

GRADING. We will have at least a mid-term (33%) and final (33%) exams homework and an end-of-term project (33%)in order to have a final grade.

Class Format: This is a lecture class and laboratory practice. It is anticipated that the students participate actively asking questions and general class discussions. Studying and keeping up with the reading will help the student to get he most out of the lectures and laboratory exercises.

GG Learning Objectives:

GG department has defined 5 learning objectives for the undergraduate degree program related to Relevance of Geology and Geophysics, Technical knowledge, Scientific method,
Oral and written skills, and Evaluating Phenomena. This course directly incorporates content relevant to 4 of those:

- SLO1 - throughout the course you will learn about the relevance of magnetism to understanding and providing for human needs, and to impacts on society and planet Earth.
- SLO2 - you will solve problems using real world data sets
- SLO4 - you will reconstruct knowledge in a written report (final project).
- SLO5 - in all assignments you will evaluate, interpret, and summarize basic principles to explain complex phenomena at the interfaces of geology, biology, rock magnetism, soil science, environment and human industry.